IFAS: India's No. 1 Institute CSIR UGC NET, SET & All MSc. Entrance Exams

The function of education is to teach one to think intensively and to think critically Intelligence plus character—that is the goal of true education

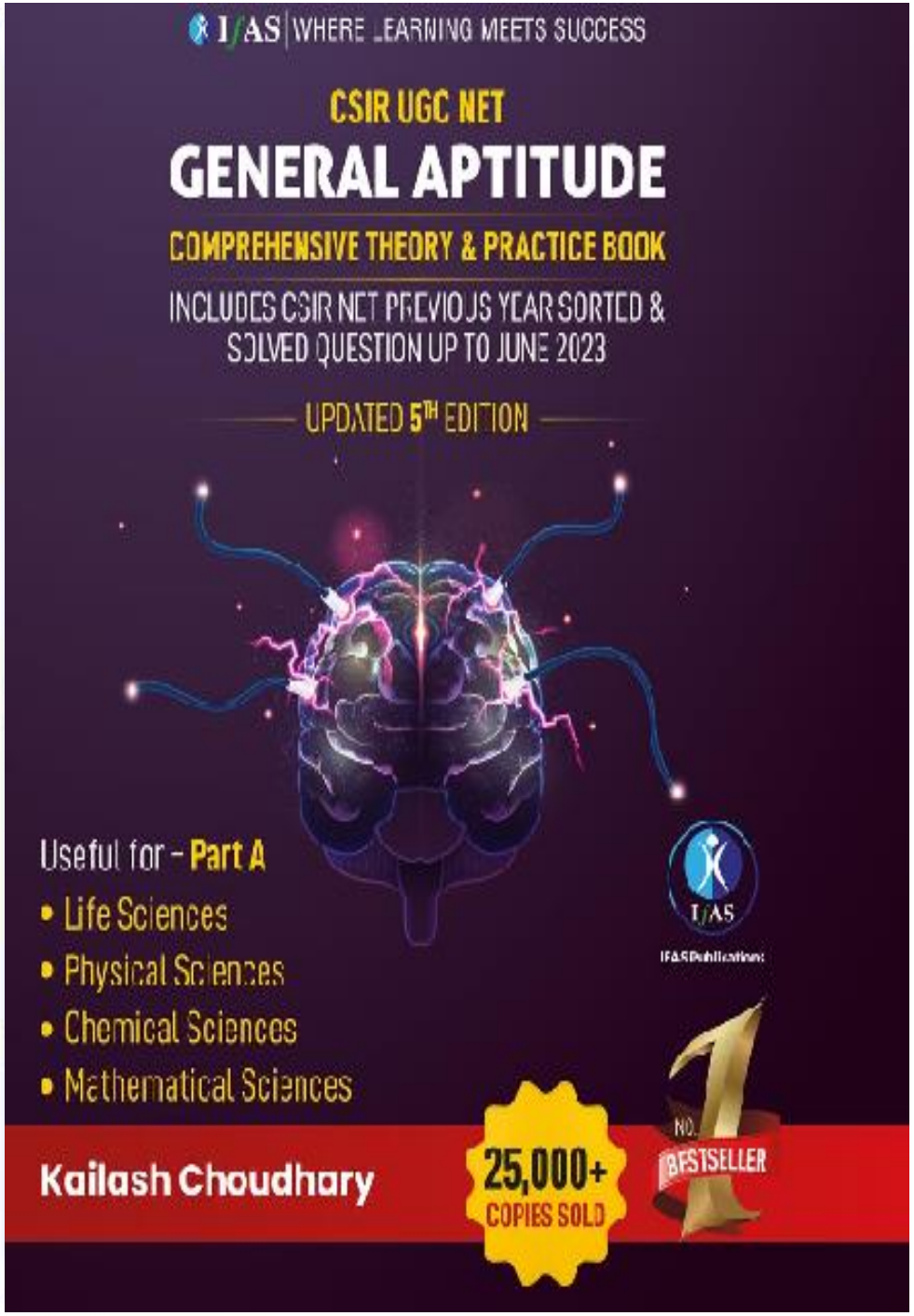
CSIR NET - GENERAL APTITUDE

QUANTITATIVE APTITUDE

L-14 | **Height and distance**

IfAS

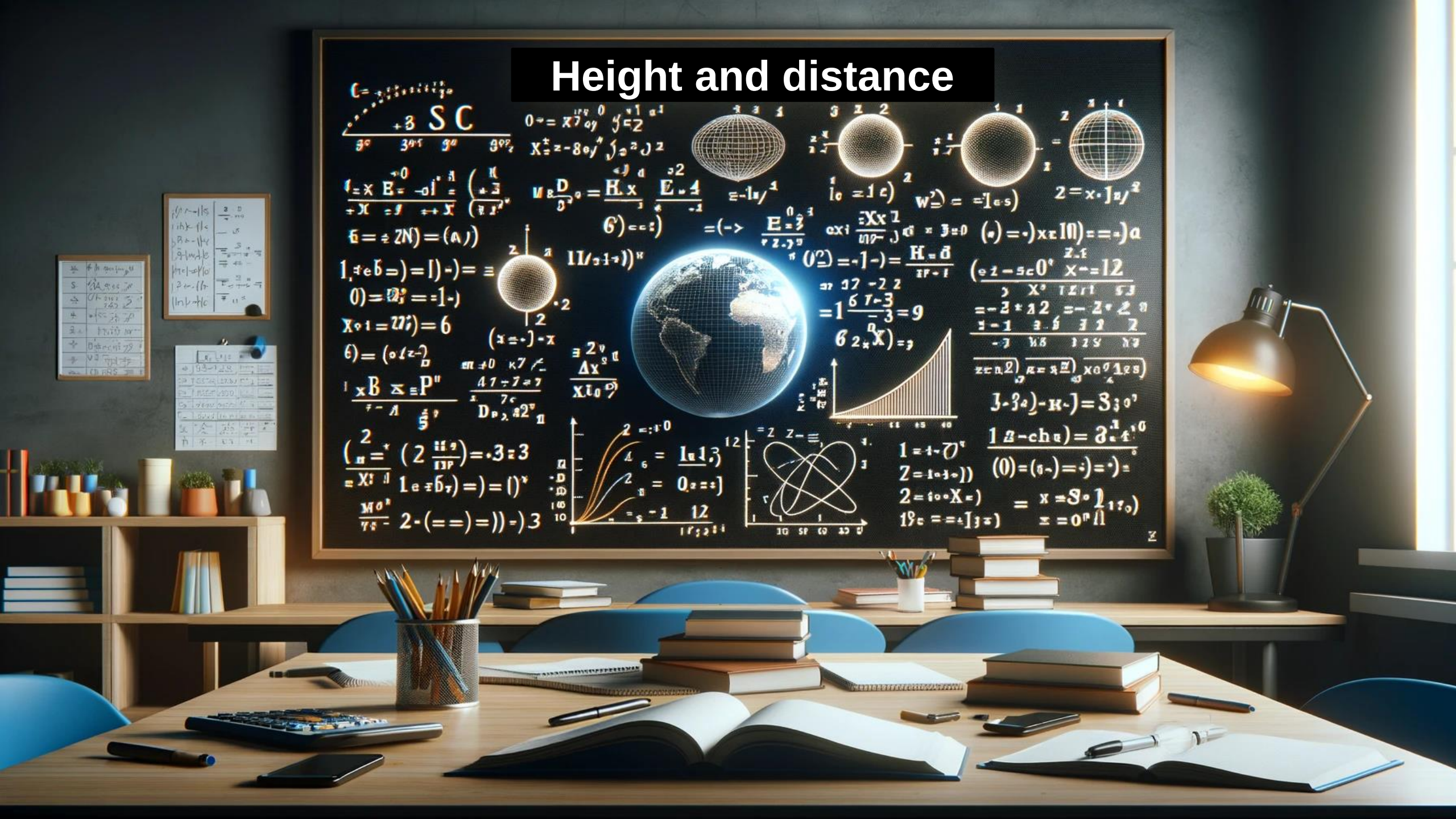
Order Online and Get Free Delivery Across India



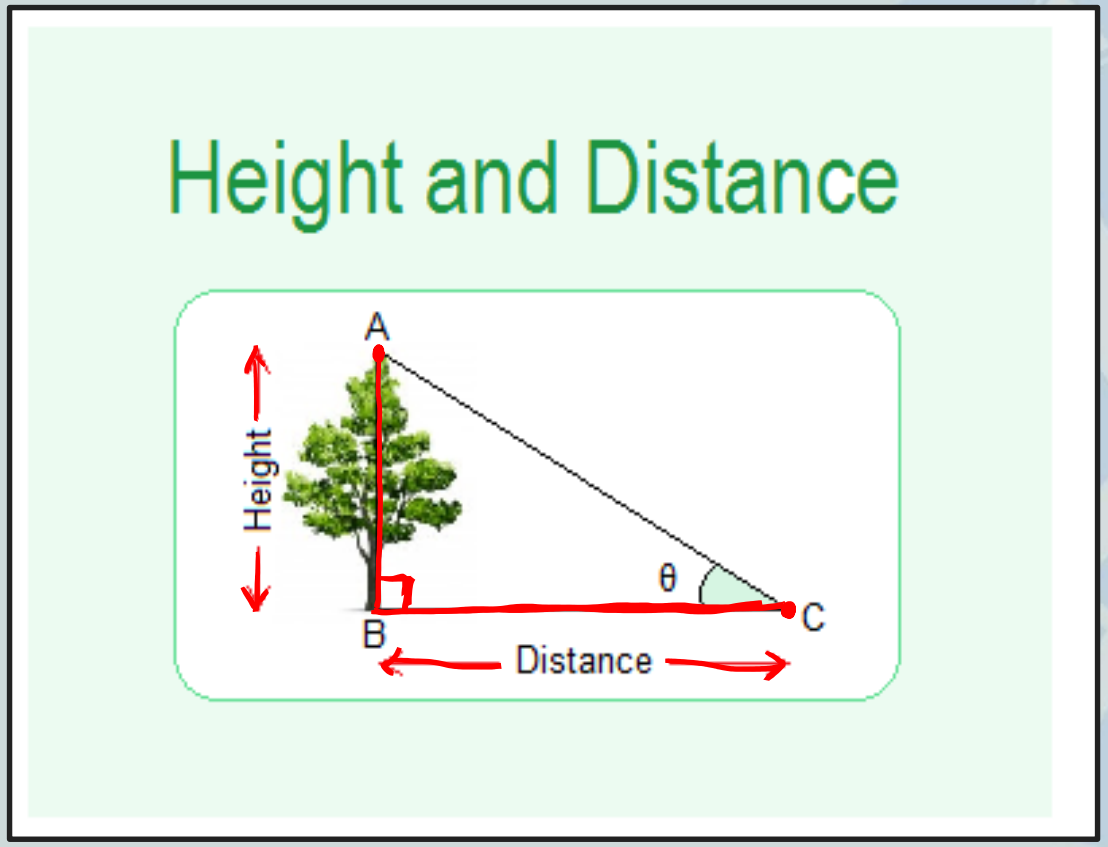
Topic Covered in Today's Session

1. What is height and distance ?
2. Trigonometric angles
3. Practice questions

Height and distance



What is height and distance ?



Line of Sight – The imaginary horizontal straight line drawn from the observer's eye to the objects to be viewed. It gives an accurate idea of the observer's view.

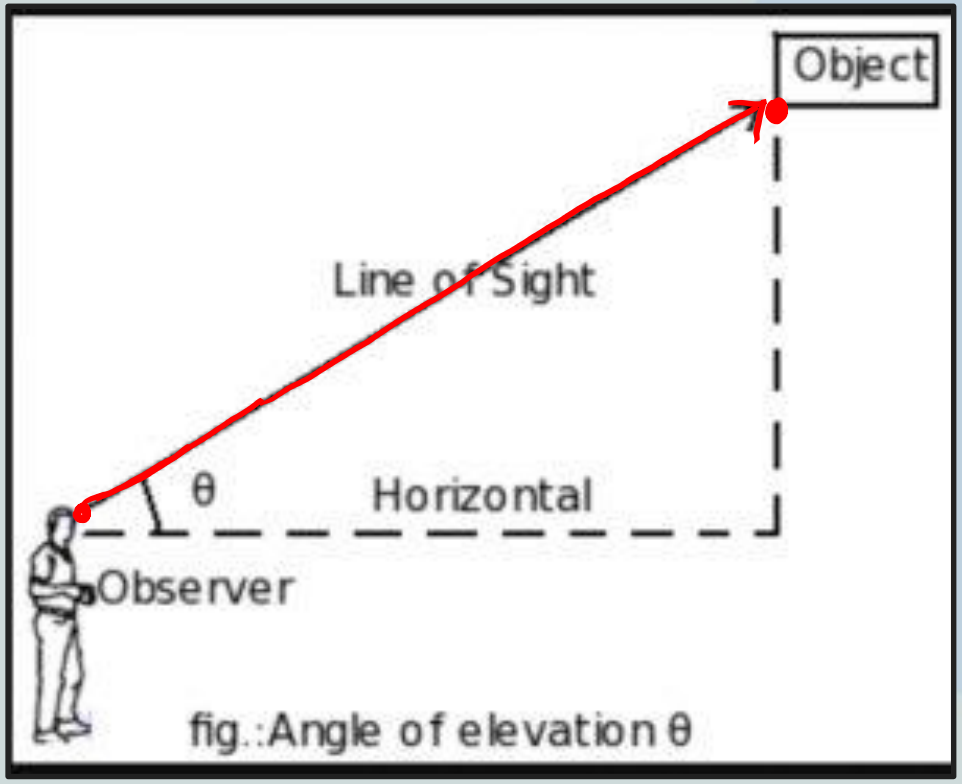


fig.:Angle of elevation θ

Horizontal line – The line passing parallel to the ground or surface is called a horizontal line. The horizontal line is shown in the above figure.

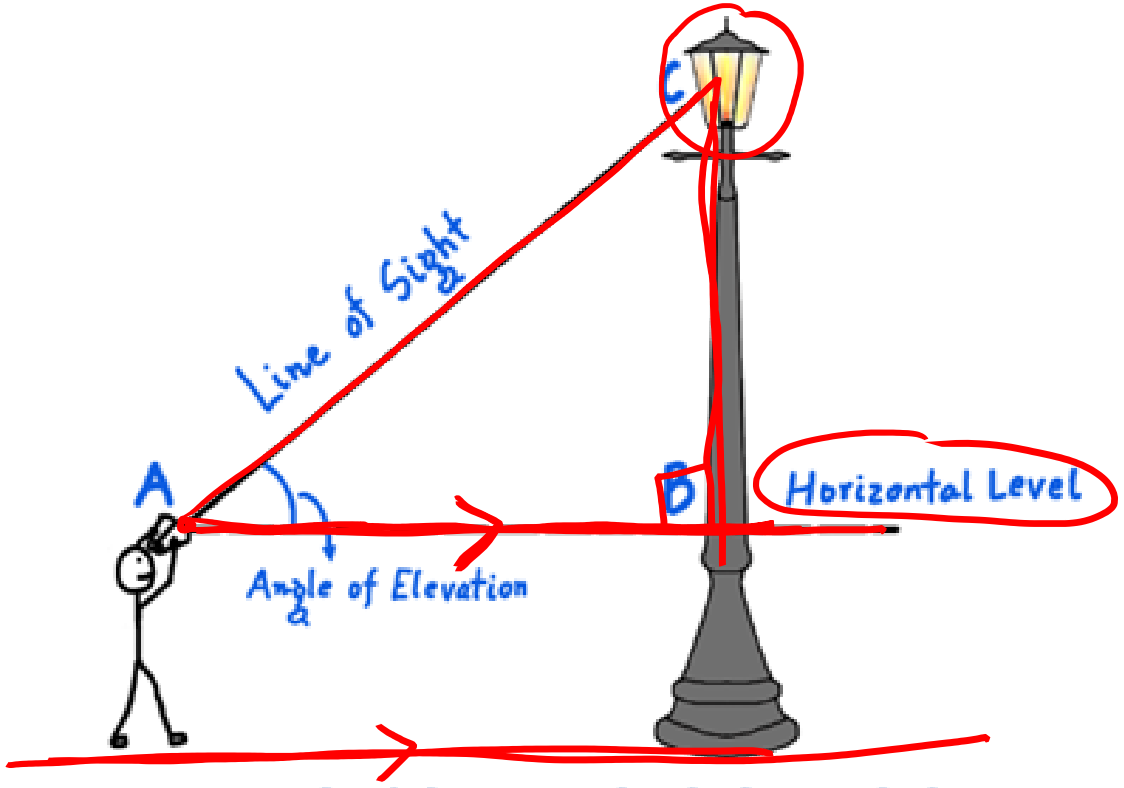


Figure 1: Angle of Elevation: A boy looking at the lamp

The angle of Elevation – The angle formed by the light of sight with the horizontal line when observers view the object situated upward over the horizontal line. It is formed only when the observer views the upward-placed object.

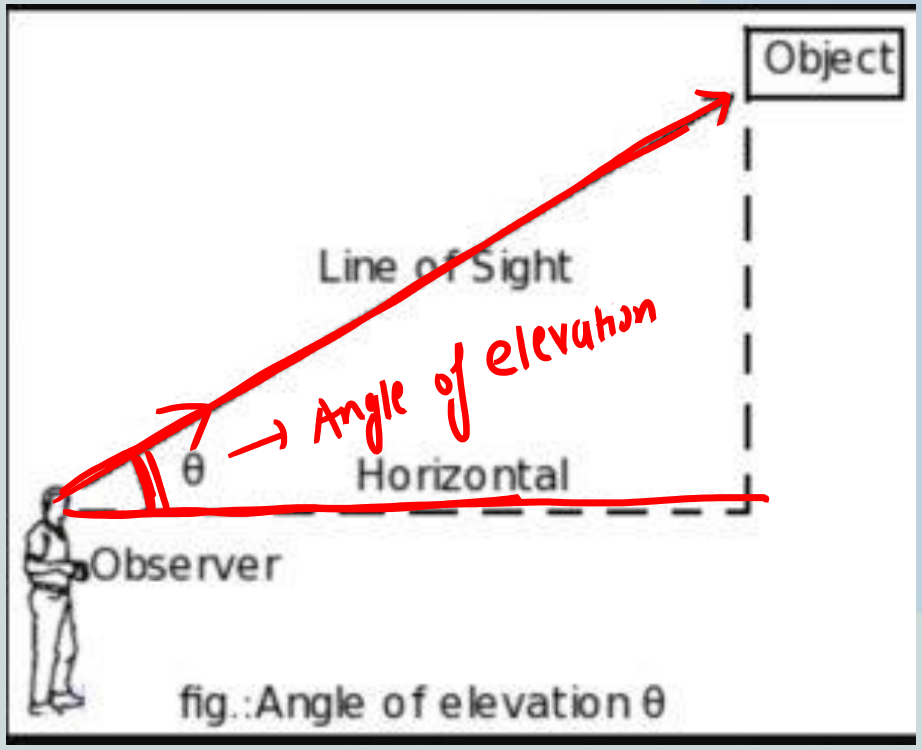


fig.:Angle of elevation θ

The angle of Depression – The angle of depression is the inclination of light of sight and horizontal line when observers view the downward object. It is formed only when the observer views the object at the ground from any height.

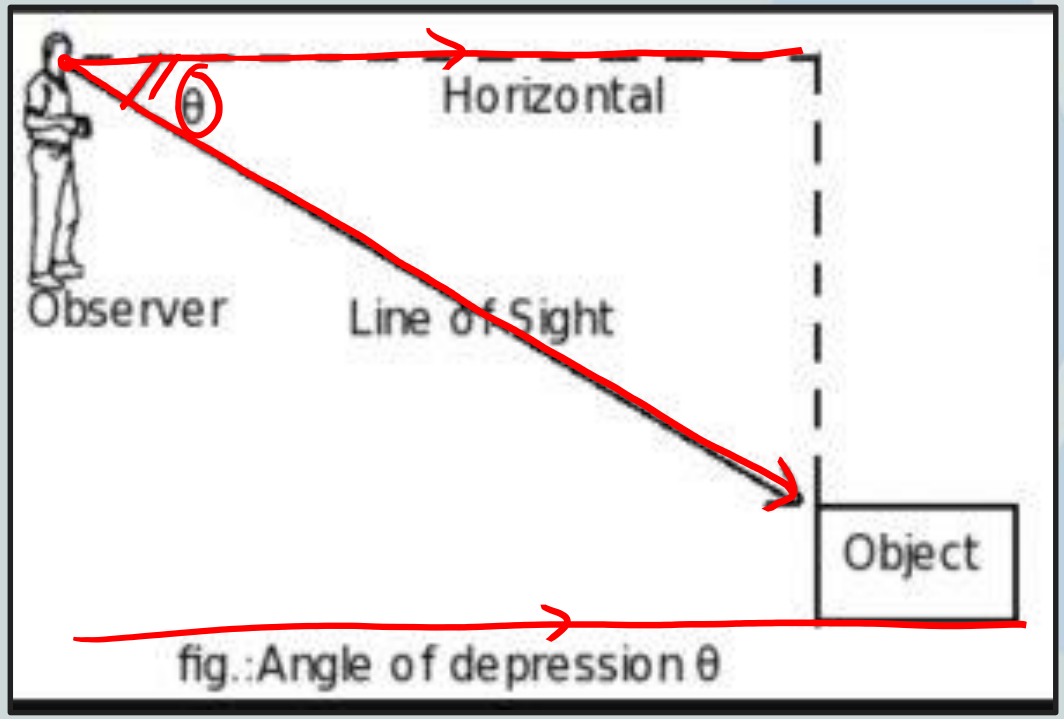
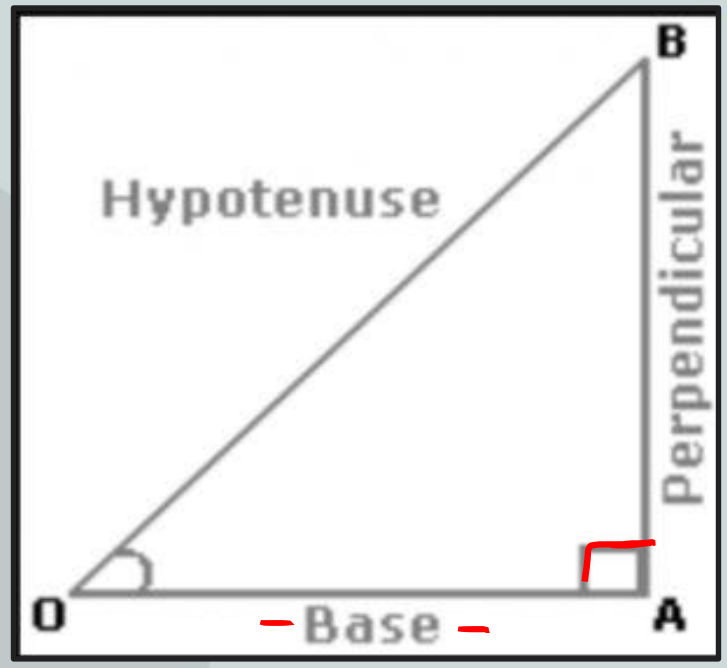


fig.:Angle of depression θ

Heights and Distances in Trigonometry



The trigonometric Ratios and formulae are mentioned below:

Angle

$\sin\theta$ = perpendicular/hypotenuse = AB/OB

$\cos\theta$ = base/hypotenuse = OA/OB

$\tan\theta$ = perpendicular/base = AB/OA

$\operatorname{cosec}\theta$ = 1/$\sin\theta$ = OB/AB

$\sec\theta$ = 1/$\cos\theta$ = OB/OA

$\cot\theta$ = 1/$\tan\theta$ = OA/AB

P/H B/H P/B

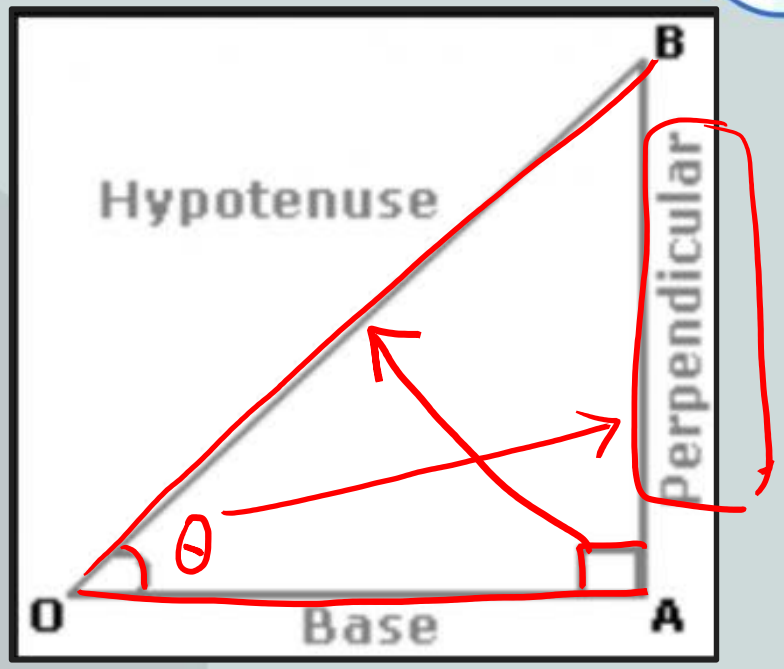
S C T

$$\operatorname{Cosec}\theta = \frac{1}{\sin\theta} = \frac{H}{P}$$

$$\sec\theta = \frac{1}{\cos\theta} = \frac{H}{B}$$

$$\cot\theta = \frac{1}{\tan\theta} = \frac{B}{P}$$

Heights and Distances in Trigonometry



The trigonometric Ratios and formulae are mentioned below:

Sinθ = perpendicular/hypotenuse = AB/OB

Cosθ = base/hypotenuse = OA/OB

Tanθ = perpendicular/base = AB/OA

Cosecθ = 1/Sinθ = OB/AB

Secθ = 1/Cosθ = OB/OA

Cotθ = 1/Tanθ = OA/AB

Trigonometric angles

$\left(\tan\theta = \frac{\sin\theta}{\cos\theta}\right)$

Table 1

∠A	0^0	30^0	45^0	60^0	90^0
sin A	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos A	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan A	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞
cosec A	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
sec A	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cot A	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Q1. From a point 350m away from the foot of the tower, the topmost point of the tower is observed by an observer making an angle of elevation of 45°. Find the height of the tower in meters?

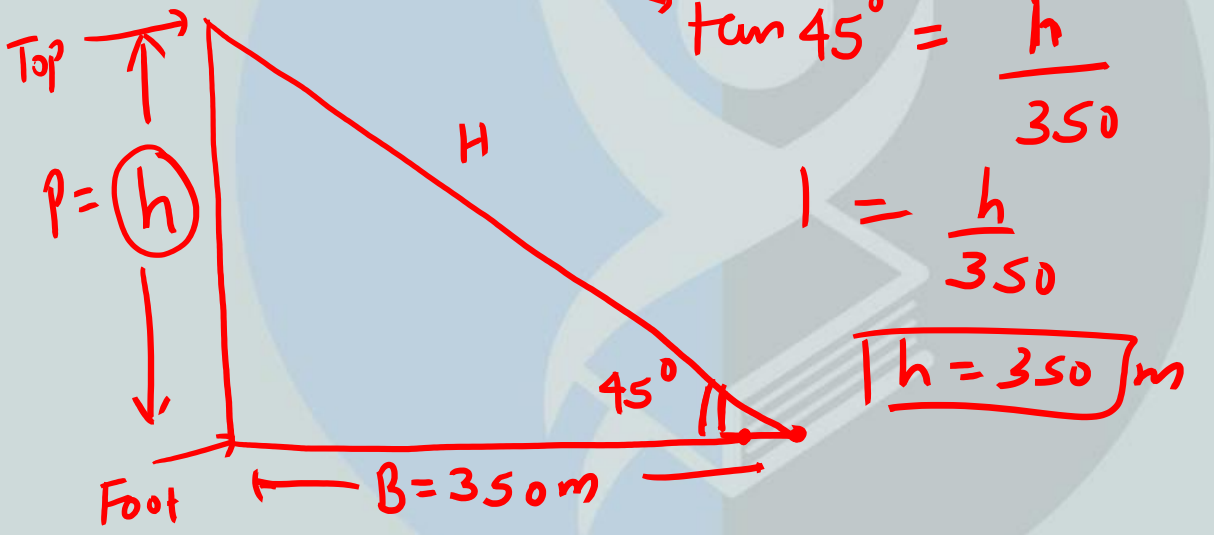
1. 460m
2. 350m
3. 250.5m
4. 315.5m

$\tan\theta = \frac{P}{B}$

$\tan 45^\circ = \frac{h}{350}$

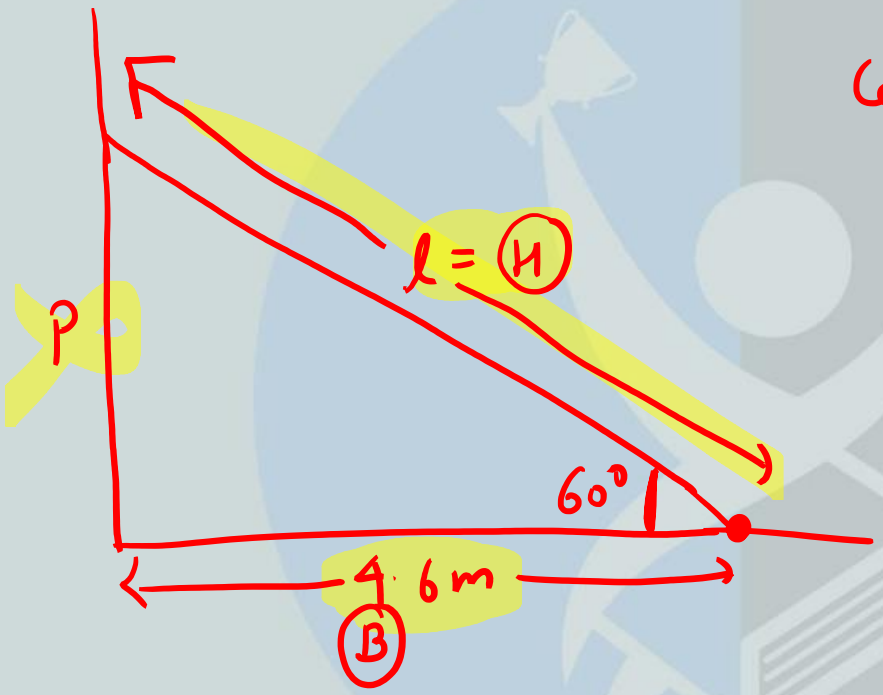
$1 = \frac{h}{350}$

$h = 350$ m



Q2. The angle of elevation of a ladder leaning against a wall is 60° and the foot of the ladder is 4.6 m away from the wall. The length of the ladder is:

1. 8.6m
2. 9.2m
3. 7.8m
4. 10m



$\cos 60 = \frac{B}{H}$

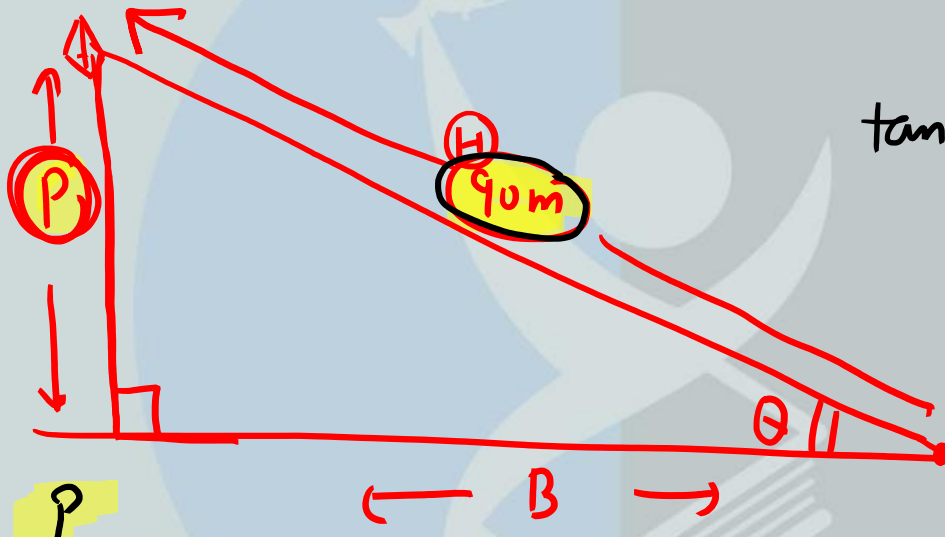
$\frac{1}{2} = \frac{4.6}{l}$

$l = 9.2\ m$

P B P
H H B

Q3. The length of a string between a kite and a point on the ground is 90 metres. If the string makes an angle θ with the ground level such that tanθ =15/8, how high is the kite? Assume that there is no slack in the string.

1. 79.41m
2. 81.41m
3. 91.61m
4. 61.54m



$\tan\theta = \frac{15}{8}$

$\tan\theta = \frac{P}{B} = \frac{15}{8}$

P B P
H H B

$H = \sqrt{P^2 + B^2}$

$H = \sqrt{15^2 + 8^2}$

$H = \sqrt{225 + 64}$

$H = \sqrt{289}$

$H = 17$

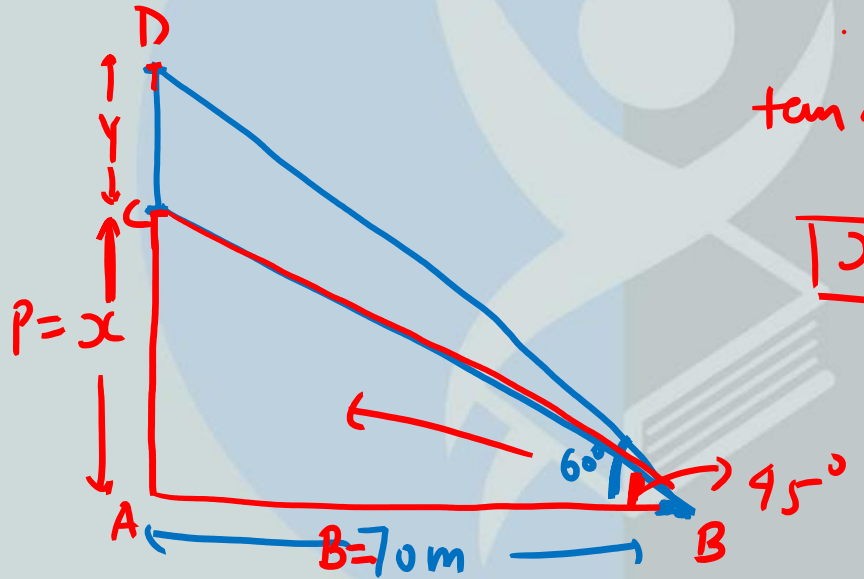
H — 17 — 90 m

P — 15 — ?

17 ≡ 90
1 ≡ $\frac{90}{17}$
15 ≡ $\frac{90}{17} \times 15 = 79.41m$

Q4. A vertical tower stands on a horizontal plane and is surmounted by a vertical flag-staff. At a point on the plane 70 metres away from the tower, an observer notices that the angles of elevation of the top and the bottom of the flag-staff are respectively 60° and 45°. Find the height of the flag-staff and that of the tower.

1. 35.28m
2. 45.40m
3. 51.24m
4. 65.56m



ΔABC

$\tan 45 = \frac{x}{70}$

$x = 70$ m

ΔABD

$\tan 60 = \frac{P}{B}$

$\sqrt{3} = \frac{70+y}{70}$

$70\sqrt{3} = 70+y$

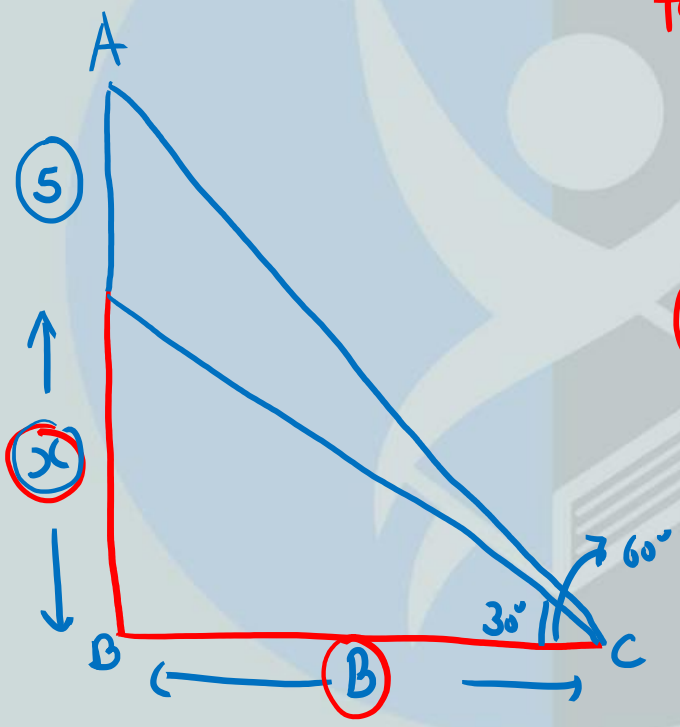
$70\sqrt{3} - 70 = y$

$70(\sqrt{3}-1) = y$

$51.24m = 70 \times 0.73 = y = 70(1.73-1)$

Q5. A vertical tower stands on a horizontal plane and is surmounted by a vertical flag-staff of height 5 metres. At a point on the plane, the angles of elevation of the bottom and the top of the flag-staff are respectively 30° and 60°. Find the height of the tower.

1. 3.5m
2. 2.5m
3. 4.5m
4. 5.0m



$\tan 30 = \frac{x}{B}$

$\frac{1}{\sqrt{3}} = \frac{x}{B}$

$\sqrt{3} = \frac{B}{x}$ — (1)

$\tan 60 = \frac{x+5}{B}$

$\sqrt{3} = \frac{x+5}{B}$ — (2)

$\sqrt{3} \times \sqrt{3} = \frac{B}{x} \times \frac{x+5}{B}$

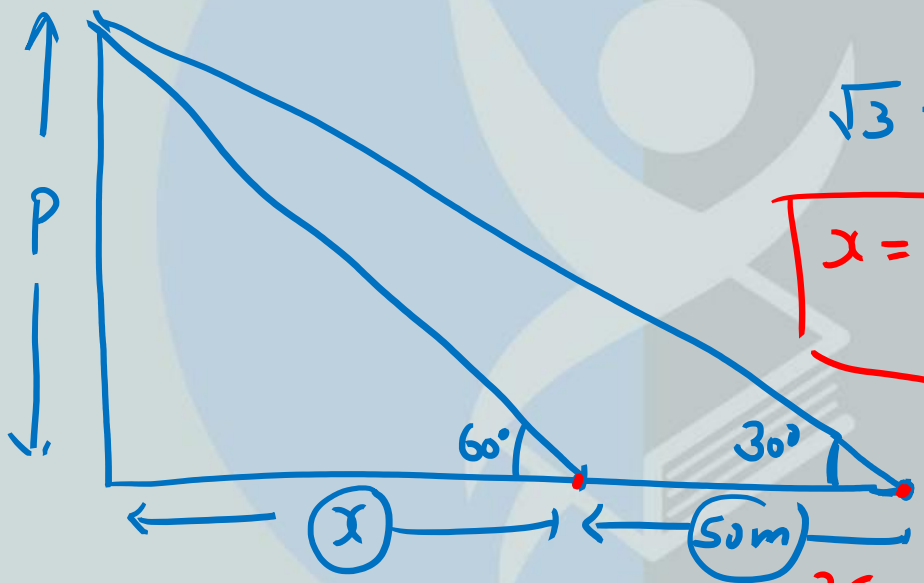
$3 = \frac{x+5}{x}$

$3x - x = 5$

$x = 2.5\ m$

Q6. A person observed the angle of elevation of the top of a tower as 30°. He walked 50 m towards the foot of the tower along level ground and found the angle of elevation of the top of the tower as 60°. Find the height of the tower.

1. 43.3 m
2. 33.33 m
3. 41.33 m
4. 52.6 m



$\tan 60 = \frac{P}{B}$

$\sqrt{3} = \frac{P}{x}$

$x = \frac{P}{\sqrt{3}}$

$\tan 30° = \frac{P}{B}$

$\frac{1}{\sqrt{3}} = \frac{P}{x+50}$

$x + 50 = \sqrt{3}P$

$\frac{P}{\sqrt{3}} + 50 = \sqrt{3}P$

$\sqrt{3}P - \frac{P}{\sqrt{3}} = 50$

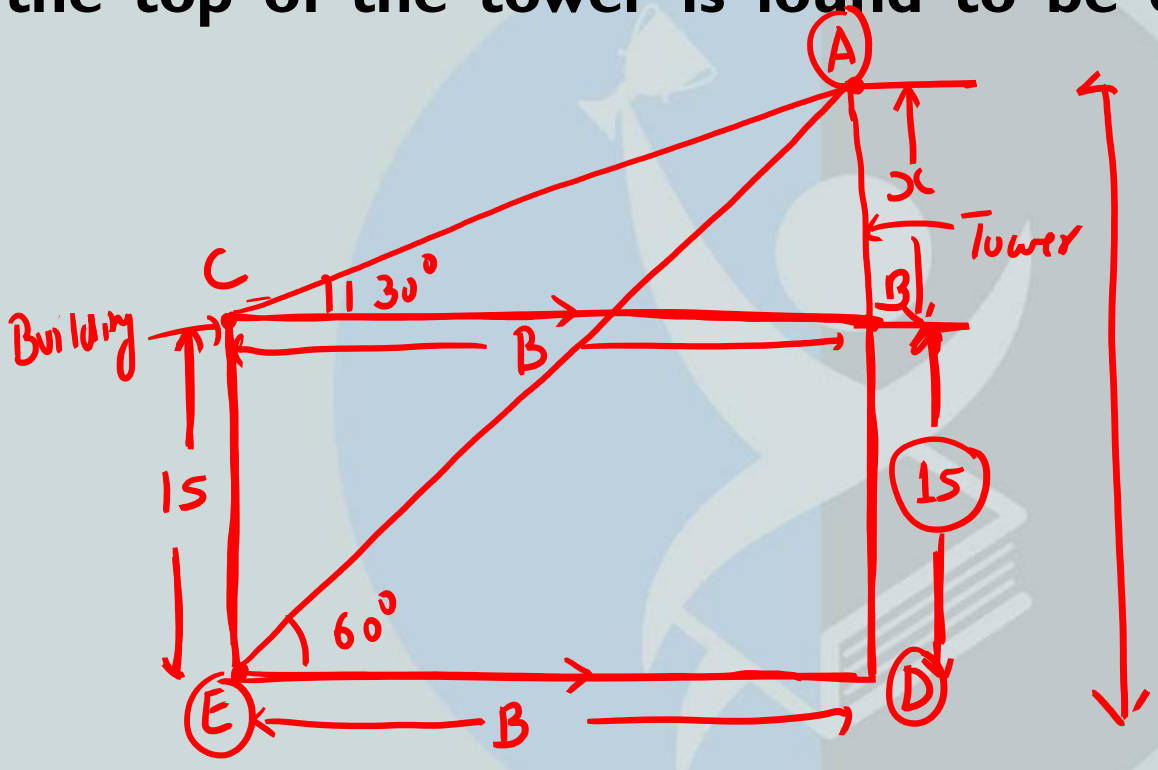
$\frac{3P - P}{\sqrt{3}} = 50$

$2P = 50\sqrt{3}$

$P = 25\sqrt{3}$ m

Q7. From the top of a building 15 m high the angle of elevation of the top of a tower is found to be 30°. From the bottom of the same building, the angle of elevation of the top of the tower is found to be 60°. Find the height of the tower.

1. 34.6m
2. 22.5m
3. 25.5m
4. 30.5m



ΔABC

$\tan 30 = \frac{x}{B}$

$\frac{1}{\sqrt{3}} = \frac{x}{B}$

$B = \sqrt{3}x$

ΔADE

$\tan 60 = \frac{x+15}{B}$

$\sqrt{3} = \frac{x+15}{\sqrt{3}x}$

$3x = x+15$

$2x = 15$

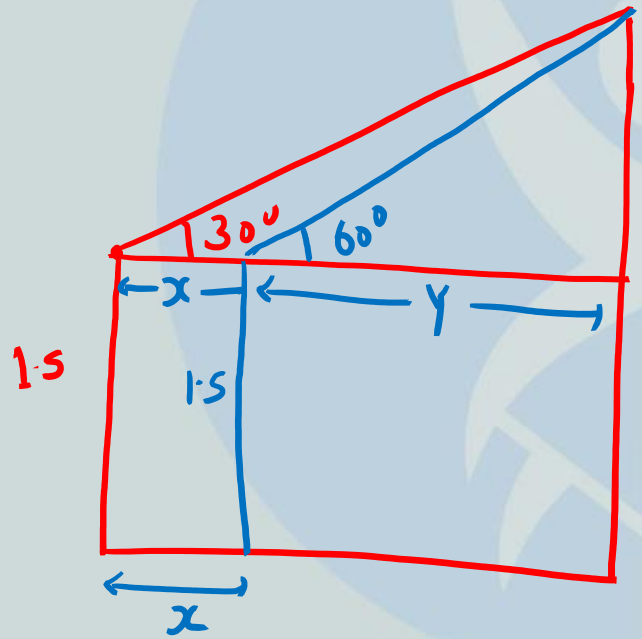
$x = 7.5$

Tower's height =

$7.5 + 15 = 22.5m$

Q8. A 1.5 m tall boy is standing at some distance from a 30 m tall building. The angle of elevation from his eyes to the top of the building increases from 30° to 60° as he walks towards the building. Find the distance he walked towards the building.

1. $19\sqrt{3}$ m
2. $21\sqrt{3}$ m
3. $23\sqrt{3}$ m
4. $17\sqrt{3}$ m



$28 \cdot 5$

$1 \cdot 5$

$\tan 30 = \frac{28 \cdot 5}{x+y}$ | $\tan 60 = \frac{28 \cdot 5}{y}$

$\frac{1}{\sqrt{3}}(x+y) = 28 \cdot 5$ | $\sqrt{3} = \frac{28 \cdot 5}{y}$

$\frac{1}{\sqrt{3}}\left[x + \frac{28 \cdot 5}{\sqrt{3}}\right] = 28 \cdot 5$ | $y = \frac{28 \cdot 5}{\sqrt{3}}$

$\frac{1}{\sqrt{3}}\left[\frac{\sqrt{3}x + 28 \cdot 5}{\sqrt{3}}\right] = 28 \cdot 5$

$\Rightarrow \frac{(\sqrt{3}x + 28 \cdot 5)}{3} = 28 \cdot 5$

$\sqrt{3}x + 28 \cdot 5 = 85 \cdot 5$

$x = \frac{57}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{57\sqrt{3}}{3} = 19\sqrt{3}$ m

Q9. A 1.6 m tall girl stands at a distance of 3.2 m from a lamp-post and casts a shadow of 4.8 m on the ground. Find the height of the lamp-post.

1. 2.88 m
2. 2.66 m
3. 5.55m
4. 2.33m

Q10 Two ships are sailing in the sea on the two sides of a lighthouse. The angle of elevation of the top of the lighthouse is observed from the ships are 30° and 45° respectively. If the lighthouse is 100 m high, the distance between the two ships is:

1. 173 m
2. 200 m
3. 273 m
4. 300 m

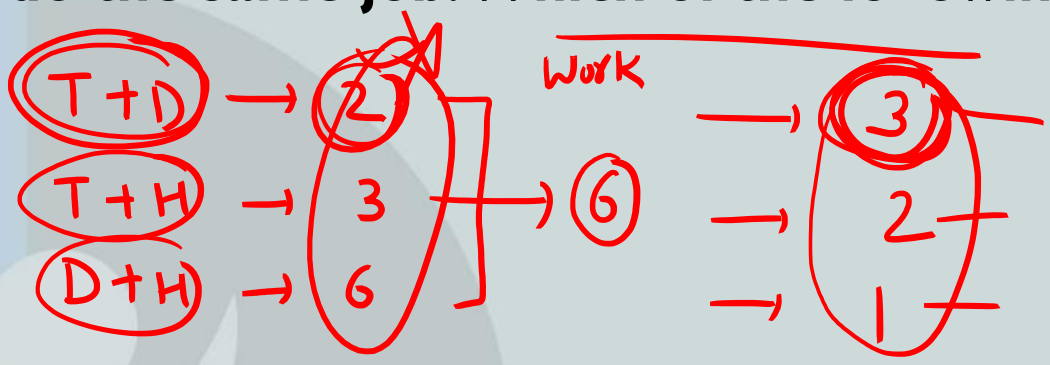
Q11. A person standing on the bank of a river observes that the angle of elevation of the top of a tree on the opposite bank is 45^0. When he moves 20m away from the bank, he finds the angle of elevation to be 30^0. Find the height of the tree.

1. $10(\sqrt{3} + 1)m$
2. $15\sqrt{3}m$
3. $200(\sqrt{3} + 1)m$
4. $10(\sqrt{3} - 1)m$

Q8. It takes 2 hours for Tiwari and Deo to do a job. Tiwari and Hari take 3 hours to do the same job. Deo and Hari take 6 hours to do the same job. Which of the following statements is incorrect?

(1) Tiwari alone can do the job in 3 hours
(2) Deo alone can do the job in 6 hours
(3) Hari does not work at all
(4) Hari is the fastest worker

HW



$2T + 2D + 2H = 6$

$2(T + D + H) = 6$ 3

$T + D + H = 3$

$3 + H = 3$

$H = 0$

Q9. A, B and C can complete a work in 10, 12 and 15 days respectively. A left the work 5 days before the work was completed and B left 2 days after A had left. The number of days required to complete the whole work is?

(a) 8⅔ days (b) 6⅔ days (c) 7 days (d) 6 days

$x - 5 + 2 = (x - 3)$

HW

A → 10
B → 12
C → 15

60 → 6, 5, 4

x days

A + B + C

$6(x-5) + 5(x-3) + 4x = 60$

$6x - 30 + 5x - 15 + 4x = 60$

$15x = 60 + 45$

$x = \frac{105}{15}$

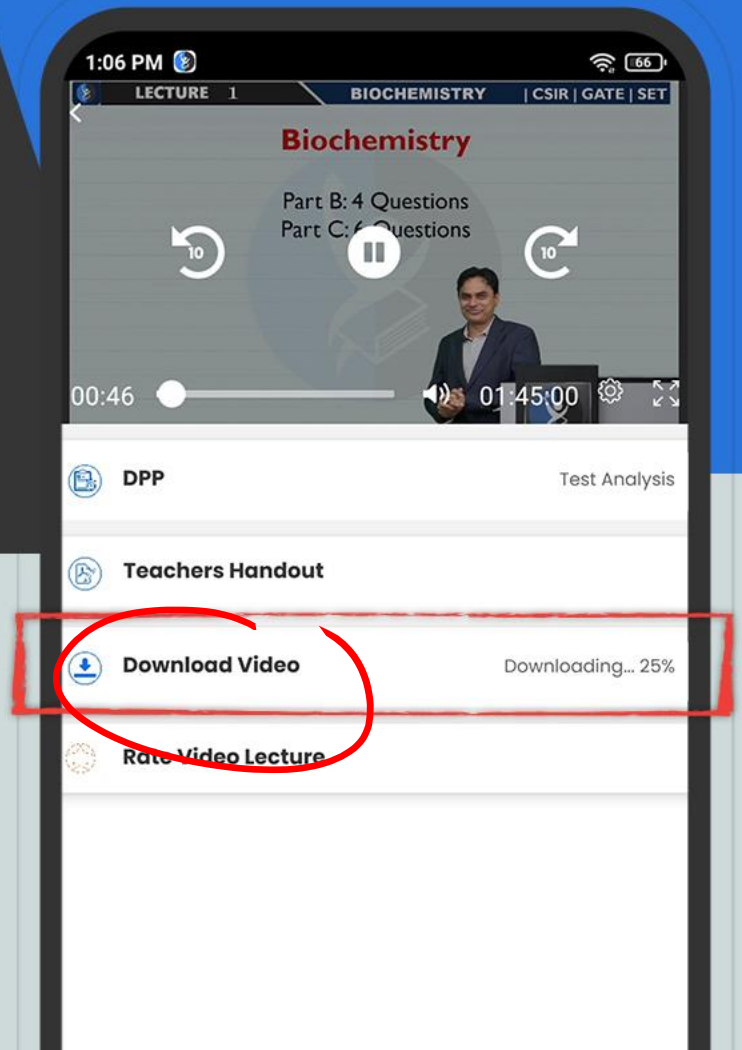
$x = 7$ days

IfAS

UGC NET | SET | PSC

SAVE YOUR INTERNET DATA USAGE!

Minimize Internet Usage by Downloading Lectures from the IFAS App & Access them Offline



IfAS

Harshada Sharma

Earned: ₹25,500

"As is widely recognized, IFAS stands as India's leading institute for IIT JAM examination preparation. My Personal philosophy has always revolved around helping others and I've had the pleasure of introducing the IFAS Online Course to 12 of my classmates and juniors, which in turn allowed me to earn 25,500 rupees. You too can join in and refer your friends, allowing you to earn a 5% rewards based on the fees each of your referred friends Pay"

REFER & EARN

Step – 01 Invite Friends

Share your referral code or Link with your friends.

Step – 02 Earn Cashback

On Every Purchase made using your referral code, you earn 5% instant cashback in your bank account.

Step – 03 Refer More, Earn More

Keep referring as many friends as you can and keep Earning cash as much as you can

Friendship is Sharing, Caring, Giving & Helping Each Other...!